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(54) SYSTEMS AND METHODS FOR ENHANCING PERFORMANCE OF SOFTWARE APPLICATIONS

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G06F 3/06 (2006.01)

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CPC ***G06F 3/0611*** (2013.01); ***G06F 3/0643*** (2013.01); ***G06F 3/0674*** (2013.01); *G06F 3/0659* (2013.01)

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USPC 717/174
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,345,575	A	9/1994	English et al.
6,073,232	A	6/2000	Kroeker et al.
6,081,799	A	6/2000	Beavin et al.
6,206,289	B1	3/2001	Sharpe et al.
6,226,422	B1	5/2001	Oliver
6,256,728	B1	7/2001	Witt et al.
6,442,682	B1	8/2002	Pothapragada et al.
6,574,713	B1	6/2003	Kosche et al.
6,601,167	B1	7/2003	Gibson et al.
6,606,617	B1	8/2003	Bonner et al.

(Continued)

FOREIGN PATENT DOCUMENTS

AU	2002346639	6/2003
CA	2680601	12/2009

(Continued)

OTHER PUBLICATIONS

"On the Care and Feeding of the Spinning Disks" [online] by Alex Russell. Retrieved from the internet on Feb. 27, 2012: http://infrequently.org/2011/01/on-the-care-and-feeding-of-spinning-disks, 6 pp.

(Continued)

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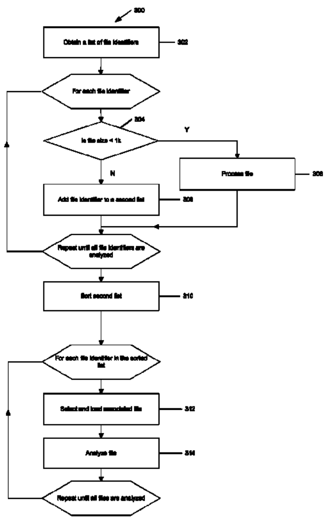
(57) ABSTRACT

A system for enhancing performance of a software application obtains a list of files to be processed by the software application, and sorts that list in the order of the physical position of files in the list on a hard drive. The files are loaded in the sorted order which can decrease or minimize the total file seeking time, thereby increasing the speed of execution of the software.

24 Claims, 5 Drawing Sheets


300
Obtain a list of file identifiers
302
For each file identifier
304
Is file size < 1k
Y
N
Process file
306
Add file identifier to a second list
308
Repeat until all file identifiers are analyzed
Sort second list
310
For each file identifier in the sorted list
Select and load associated file
312
Analyze file
314
Repeat until all files are analyzed

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,633,968	B2	10/2003	Zwiegincew et al.	
6,671,774	B1	12/2003	Lam et al.	
6,748,534	B1	6/2004	Gryaznov et al.	
6,751,780	B1	6/2004	Neff et al.	
6,981,099	B2	12/2005	Paulraj et al.	
7,000,077	B2	2/2006	Grimsrud et al.	
7,065,790	B1	6/2006	Gryaznov	
7,139,909	B2	11/2006	Lee	
7,359,890	B1	4/2008	Ku et al.	
7,380,725	B2	6/2008	McGill	
7,383,417	B2	6/2008	Yasue et al.	
7,434,261	B2	10/2008	Costea et al.	
7,437,504	B2	10/2008	Waldvogel	
7,506,374	B2	3/2009	Carmona	
7,568,233	B1	7/2009	Szor et al.	
7,581,253	B2	8/2009	Challener et al.	
7,647,297	B2	1/2010	LaChapelle et al.	
7,669,044	B2	2/2010	Fitzgerald et al.	
7,743,060	B2	6/2010	Fontoura et al.	
7,760,654	B2	7/2010	Adya et al.	
7,778,983	B2	8/2010	Jorden et al.	
7,788,650	B2	8/2010	Johnson et al.	
7,836,504	B2	11/2010	Ray et al.	
7,845,008	B2	11/2010	Waltermann et al.	
7,861,296	B2	12/2010	Costea et al.	
7,937,263	B2	5/2011	Carrier et al.	
7,949,665	B1 *	5/2011	Millard et al.	707/752
7,975,025	B1	7/2011	Szabo et al.	
7,984,503	B2	7/2011	Edwards	
1,020,922	A1	8/2011	Tikkanen et al.	
1,021,920	A1	9/2011	Asaad et al.	
1,022,512	A1	9/2011	Jarrett et al.	
8,087,081	B1	12/2011	Chun et al.	
8,087,084	B1	12/2011	Andruss et al.	
8,091,134	B2	1/2012	Benton et al.	
2002/0067515	A1	6/2002	Abe	
2003/0115479	A1	6/2003	Edwards et al.	
2003/0120952	A1	6/2003	Tarbotton et al.	
2004/0158730	A1	8/2004	Sarkar	
2004/0230748	A1	11/2004	Ohba	
2005/0195435	A1	9/2005	Kojima et al.	
2005/0216759	A1	9/2005	Rothman et al.	
2005/0219657	A1	10/2005	Sasaki et al.	
2006/0101264	A1	5/2006	Costea et al.	
2006/0161546	A1	7/2006	Callaghan et al.	
2006/0294356	A1	12/2006	Kumar et al.	
2007/0055711	A1	3/2007	Polyakov et al.	
2007/0078915	A1	4/2007	Gassoway	
2007/0156677	A1	7/2007	Szabo	
2007/0294767	A1	12/2007	Piccard et al.	
2008/0005797	A1	1/2008	Field et al.	
2008/0086290	A1	4/2008	Wilson	
2008/0155339	A1	6/2008	Lowe et al.	
2008/0195676	A1	8/2008	Lyon et al.	
2008/0209198	A1	8/2008	Majni et al.	
2008/0229016	A1	9/2008	Waites	
2009/0049550	A1	2/2009	Shevchenko	
2009/0198738	A1	8/2009	Berger et al.	
2009/0199190	A1	8/2009	Chen et al.	
2009/0222923	A1	9/2009	Dixon	
2009/0235134	A1	9/2009	Guo et al.	
2009/0249055	A1	10/2009	Itoh	
2009/0287842	A1	11/2009	Plamondon	
2010/0011029	A1	1/2010	Niemela	
2010/0017591	A1 *	1/2010	Smith et al.	713/2
2010/0023679	A1 *	1/2010	Blum	711/103
2010/0031361	A1	2/2010	Shukla	
2010/0083381	A1	4/2010	Khosravi et al.	
2010/0149593	A1	6/2010	Dowling et al.	
2010/0162400	A1	6/2010	Feeney et al.	
2010/0169972	A1 *	7/2010	Kuo et al.	726/23
2010/0241654	A1	9/2010	Wu et al.	
2010/0269032	A1	10/2010	King et al.	
2011/0271347	A1	11/2011	Zimmer et al.	
2011/0296525	A1	12/2011	Turbin	

FOREIGN PATENT DOCUMENTS

EP	0201848	11/1986
EP	1229433 A1	8/2002
EP	1835409	9/2007
EP	2194471	6/2010
EP	2251781	11/2010
JP	2007317190	12/2007
JP	2008191824	8/2008
JP	2008305225	12/2008
JP	2009020765	1/2009
JP	2010074604	4/2010
JP	2010237837	10/2010
WO	99/15953 D2	4/1999
WO	WO-2004055667	7/2004
WO	WO-2008112770	9/2008
WO	WO-2009042986	4/2009
WO	WO-2010142594	12/2010
WO	WO-2011153239	12/2011

OTHER PUBLICATIONS

"Prefetcher—Wikipedia, the free encyclopedia" [online]. Retrieved from the internet on Feb. 27, 2012: http://en.wikipedia.org/wiki/Prefetcher, 3 pp.

International Search Report, Application No. PCT/IB2013/000696, date of mailing Sep. 2, 2014.

* cited by examiner

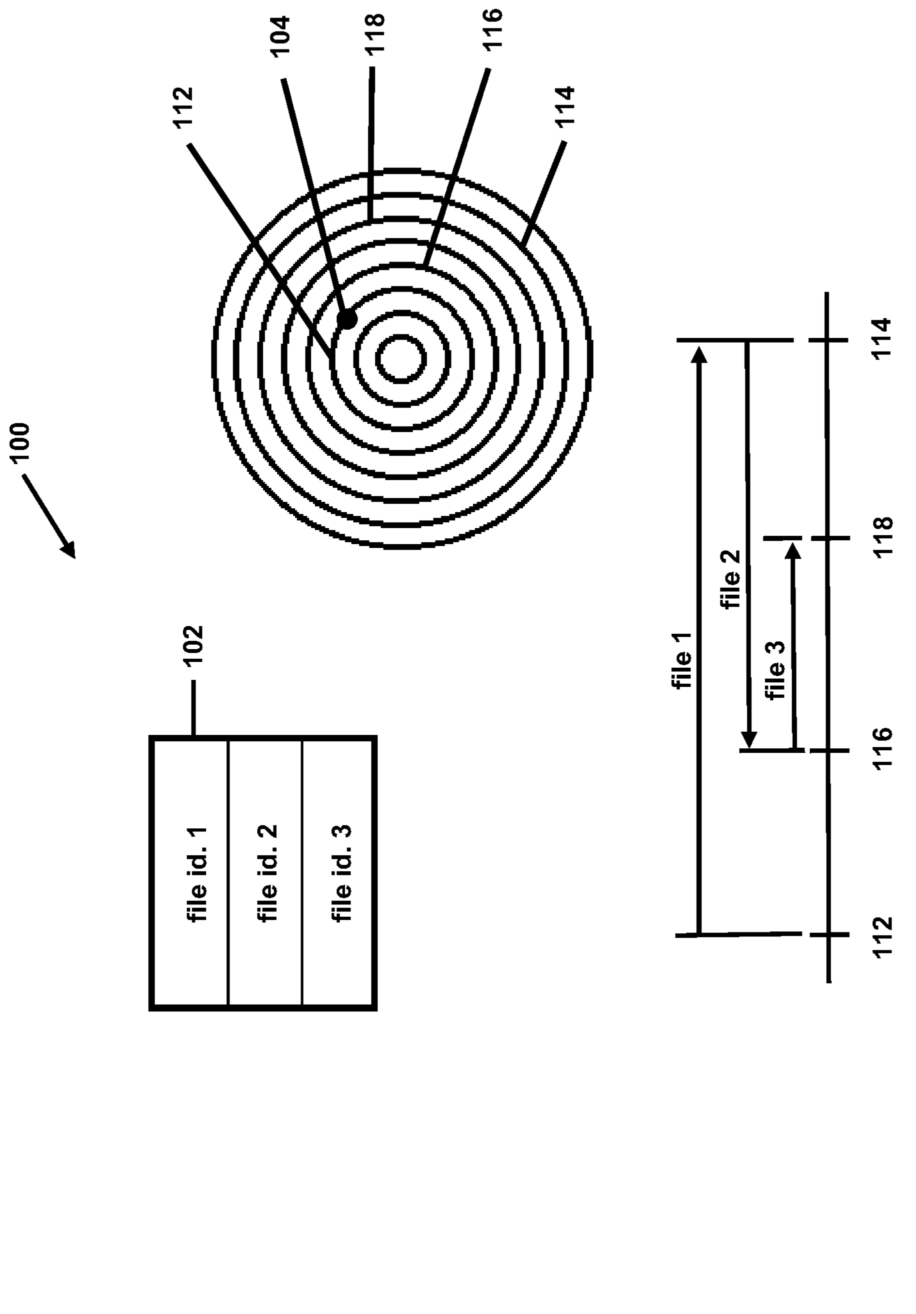

100
102
file id. 1
file id. 2
file id. 3
112
104
118
116
114
file 1
file 2
file 3
112
116
118
114

FIG. 1

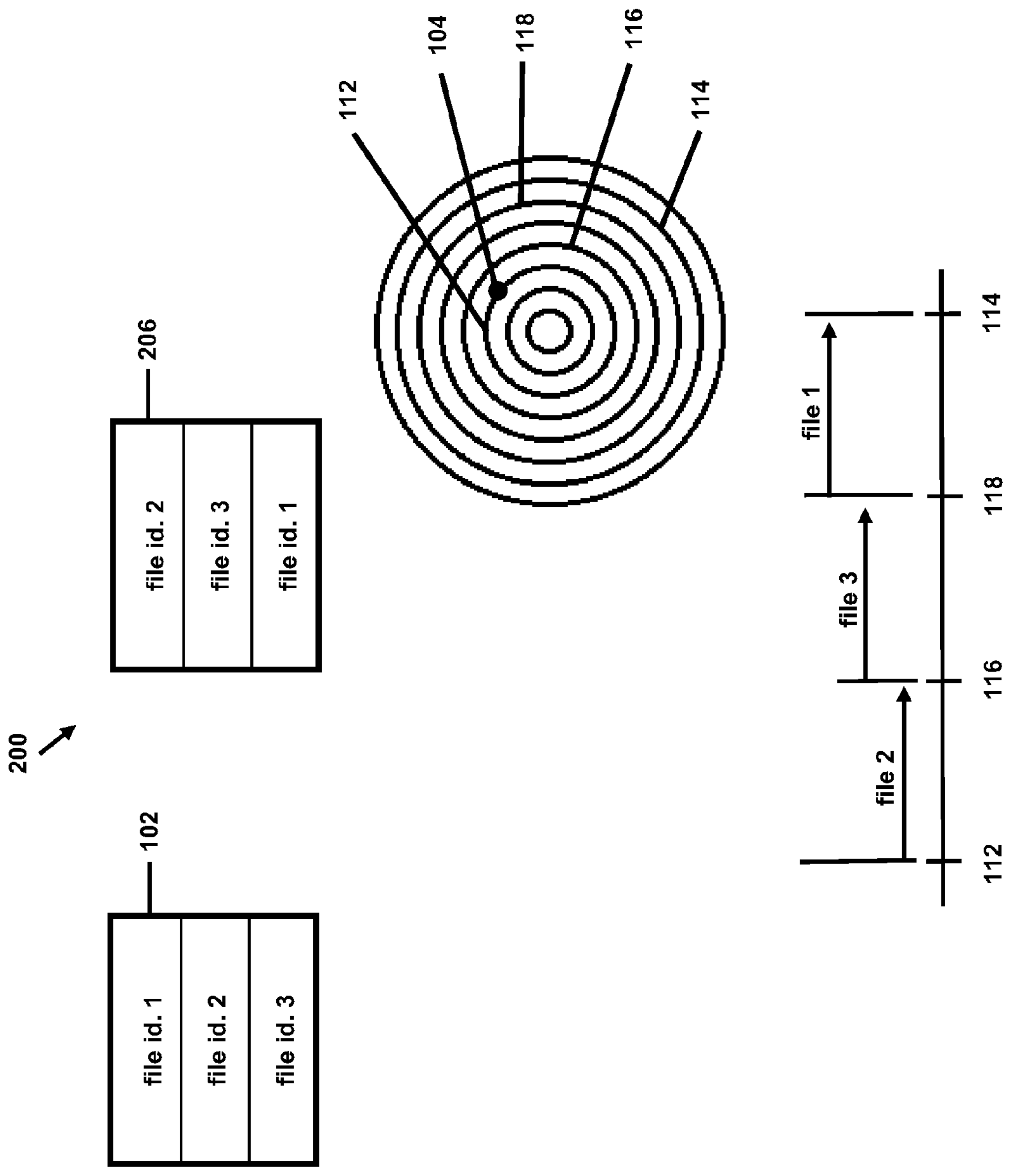

200
102
file id. 1
file id. 2
file id. 3
206
file id. 2
file id. 3
file id. 1
112
104
118
116
114
file 2
file 3
file 1
112
116
118
114

FIG. 2

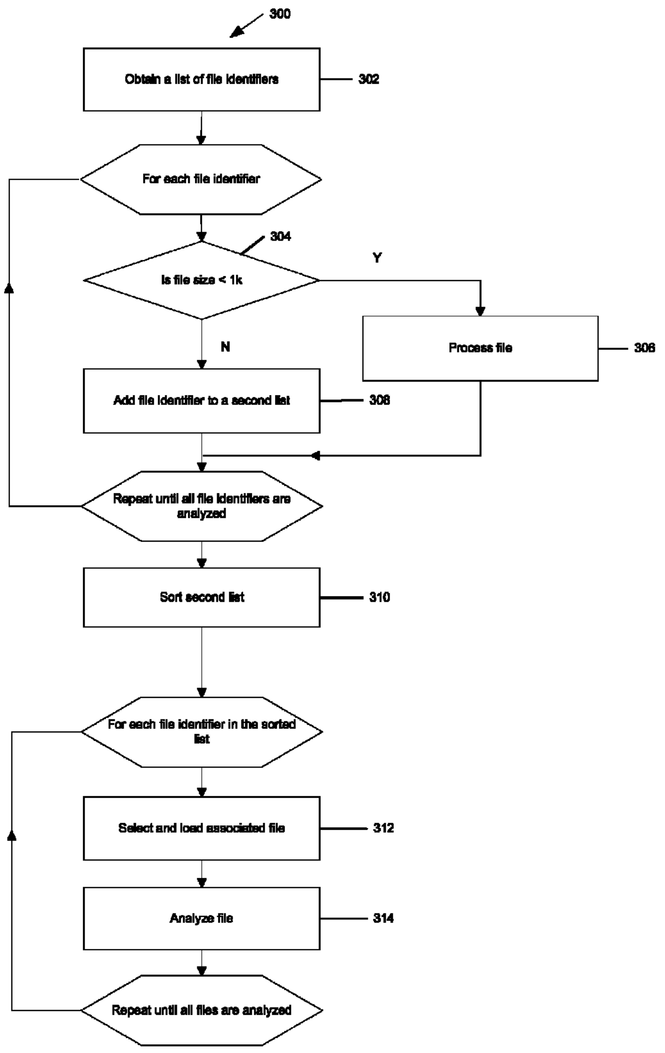

300
Obtain a list of file identifiers
302
For each file identifier
304
Is file size < 1k
Y
N
Process file
306
Add file identifier to a second list
308
Repeat until all file identifiers are analyzed
Sort second list
310
For each file identifier in the sorted list
Select and load associated file
312
Analyze file
314
Repeat until all files are analyzed

FIG. 3

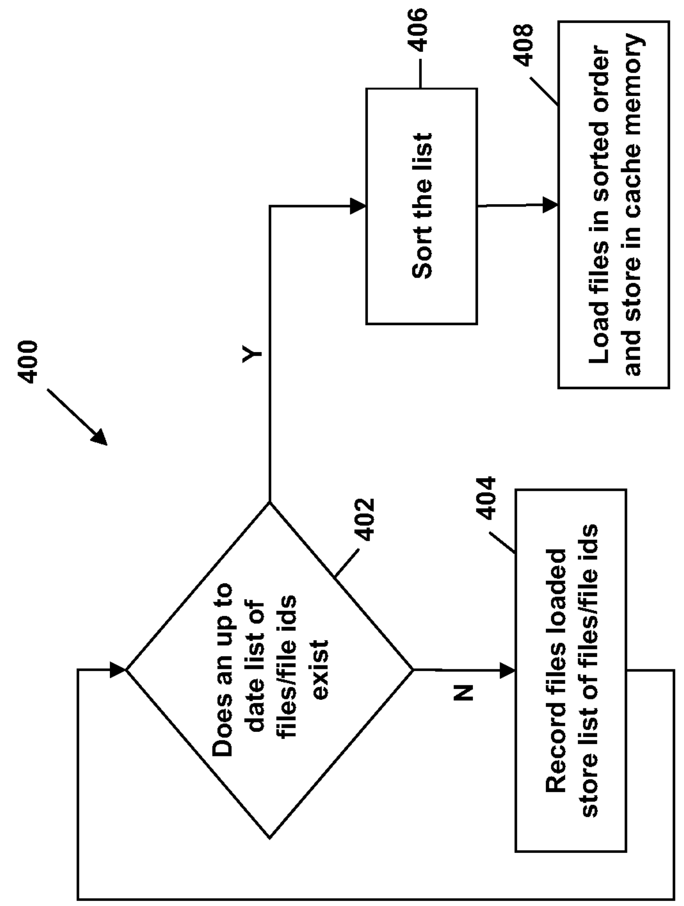

400
Does an up to date list of files/file ids exist
402
Y
N
Record files loaded store list of files/file ids
404
Sort the list
406
Load files in sorted order and store in cache memory
408

FIG. 4

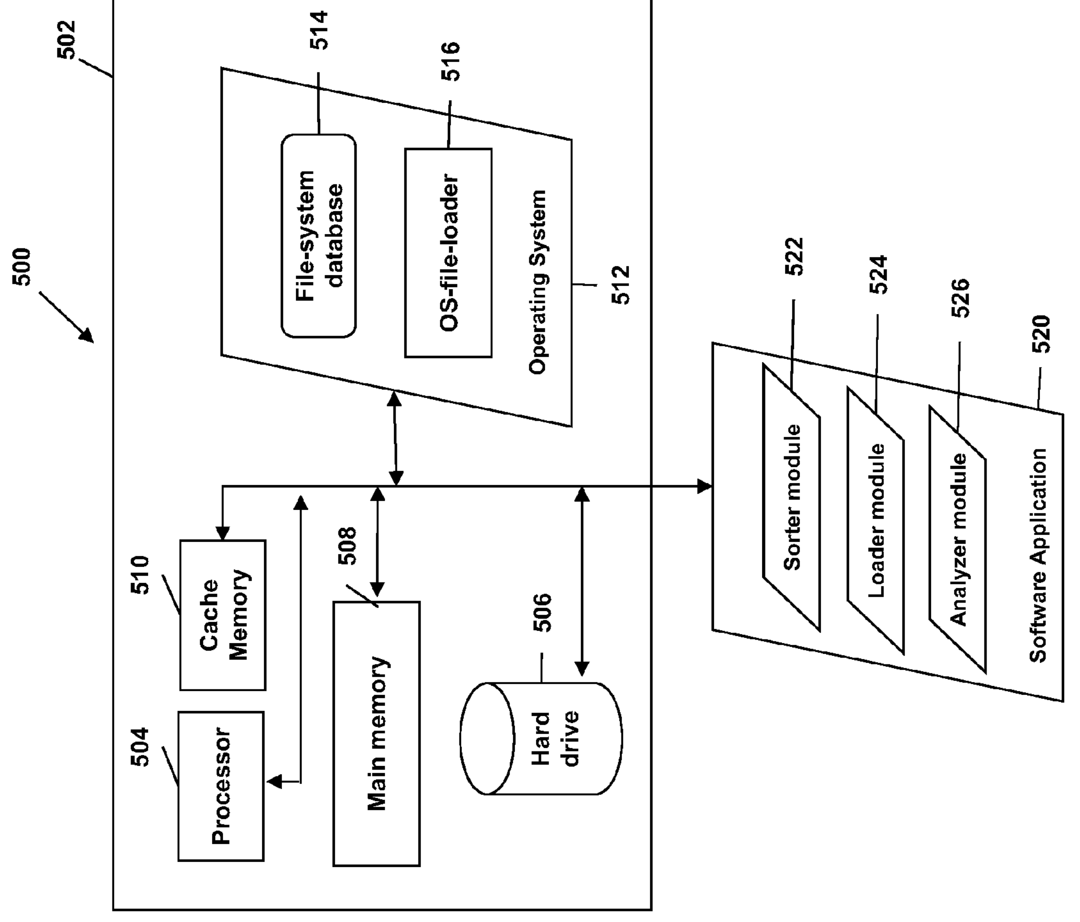

500
502
File-system database
514
OS-file-loader
516
Operating System
512
Cache Memory
510
Processor
504
Main memory
508
Hard drive
506
Sorter module
522
Loader module
524
Analyzer module
526
Software Application
520

FIG. 5

SYSTEMS AND METHODS FOR ENHANCING PERFORMANCE OF SOFTWARE APPLICATIONS

FIELD OF THE INVENTION

The invention relates generally to the field of improving performance of software products, and, more specifically, to systems and methods for efficiently loading files required by a software product.

BACKGROUND

Some software products such as anti-virus scanners, picture/video viewers, etc., process a large number of files. For example, a typical anti-virus scanner may scan all files in one or more selected folders on a hard drive of a computer or even all of the files on the hard drive. These hundreds or even thousands of files are usually loaded in the computer memory (e.g., RAM) prior to being processed.

In a typical scenario, a module of the software product requests the operating system of the computer to provide a list of files to be loaded and processed that are within a specified scope (e.g., a folder, a list of folders, a disk, etc.). The operating system returns a list of file identifiers based on the order the files are listed in a file-system database maintained by the operating system. Then, the software module, with assistance from the operating system, loads the files associated with the file identifiers in the list from permanent storage (e.g., a hard drive). The software processes a file as it is loaded, or may processes a set of files after the files in the set are loaded.

The overall performance of the software product generally depends not only on the speed of processing the loaded files, but also on the speed of loading the files. In particular, when a large number of files are to be loaded, such as by an anti-virus software, slowly loading several files can significantly affect the overall software performance. Various known techniques, however, only improve the speed of processing of the files—not the speed with which they are loaded prior to processing. According to one method, the loading and processing of files are interleaved such that the processor may analyze a previously loaded file while waiting for one or more other files to be loaded. This can increase the processor utilization, improving the overall performance of the software. These systems, however, do not improve the speed of loading of the several files, which, as described above, also adversely affects software performance. Therefore, there is a need for methods and systems for addressing file loading times, thus improving the overall performance of software products requiring processing of a large number of files.

SUMMARY OF THE INVENTION

In various embodiments of the present invention, the overall performance of a software product is improved by improving the speed of loading several files to be processed. This is achieved, in part, by obtaining additional information about the files from a list of file identifiers provided by the operating system. The additional information may include a file size, the physical position of the file on the disk, etc. Instead of accessing and loading the files in the order listed by the operating system, the files are loaded in an order based on the additional information, such as their physical position on the disk. Doing so generally causes the disk head to move in only one direction during file access. Moreover, successive movements of the disk head while accessing successive files may be shortened. This can significantly decrease the time taken to

move the disk head to access each file, thereby significantly improving the speed of loading several files. This, in turn, can improve the overall software performance.

Accordingly, in one aspect, various embodiments feature a computer-implemented method for loading the files required by a software program in computer memory. The method includes obtaining a first list of file identifiers, each being associated with a respective file, and sorting the first list based on a first attribute of each of the associated files. The method also includes selecting, in sorted order, a file identifier in the sorted first list and loading the file associated with the selected file identifier. The selecting and loading steps are repeated until each file identifier in the sorted first list is selected, and the associated file is loaded.

The application program may include one or more of a virus scanner, a spyware scanner, an ad-ware scanner, a malware scanner, a backup program, a multicopy program, a compiler, and a data-mining program. In some embodiments, the file identifier includes a file entry in a directory record, and the first attribute may include location of files associated with the file identifiers. The location may be a cluster location.

In some embodiments, obtaining the first list of file identifiers includes receiving a second list of the file identifies. For each file identifier in the second list (i) a second attribute of a file associated with the file identifier is compared with a pre-determined threshold, and (ii) based on the comparison, the file identifier is selectively added to the first list. The second attribute may include file size and the threshold may be, for example, one Kbyte.

In some embodiments, the loaded files are analyzed and the analyzing step may include scanning the loaded file for at least one of virus, spyware, adware, and malware. The analyzing step may also include copying the file to another memory location, through a network or directly, compiling the file, and/or extracting information from the file.

In some embodiments, the software program is a boot program, and obtaining the first list of file identifies includes recording, during a prior execution of the boot program, each file loaded in the computer memory. Obtaining the first list further includes storing a file identifier corresponding to the loaded file in the first list of file identifiers, storing the first list on a non-volatile memory (e.g., a hard disk, flash memory, etc.), and accessing the stored first list during a subsequent execution of the boot program. The loading step may include storing the files in a cache memory, and the method may further include accessing the files from the cache memory, and analyzing the accessed files.

In another aspect, various embodiments feature another computer-implemented method for loading, in computer memory, files required by a software program. The method includes receiving a first list of file identifies, each being associated with a respective file. For each file identifier in the first list (i) a first attribute of the associated file is compared with a pre-determined threshold, and (ii) based on the comparison, that file identifier is selectively added to a second list. The method also includes sorting the second list based on a second attribute of the files associated with the file identifiers in the second list, selecting, in sorted order, a file identifier in the sorted second list, and loading the file associated with the selected file identifier. The selecting and loading steps are repeated until each file identifier in the sorted second list is selected.

In another aspect, various embodiments feature a system for enhancing performance of a software program. The system includes a sorter module for (i) obtaining a first list of file identifiers, each being associated with a respective file, and (ii) sorting the first list based on a first attribute of each of the associated files. The system also includes a loader module for selecting, in sorted order, each file identifier in the sorted first list, and loading the file associated with the selected file identifier. The application program may include one or more of a virus scanner, a spyware scanner, an ad-ware scanner, a malware scanner, a backup program, a multicopy program, a compiler, and a data-mining program.

In some embodiments, the file identifier includes a file entry in a directory record, and the first attribute may include location of files associated with the file identifiers. The location may include a cluster location. The sorter module may be configured to receive a second list of the file identifies, and for each file identifier in the second list (i) to compare a second attribute of a file associated with the file identifier with a pre-determined threshold, and (ii) based on the comparison, to add selectively the file identifier to the first list. The second attribute may include file size and the threshold may be, e.g., one Kbyte.

In some embodiments, the system further comprises an analyzer for analyzing the loaded file. The analyzer may be configured to scan the loaded file for at least one of virus, spyware, adware, and malware. The analyzer may also be configured to copy the file to another memory location, through a network or directly, compile the file, and/or to extract information from the file.

In some embodiments, the software program is a boot program, and the sorter module is configured to record, during a prior execution of the boot program, each file loaded in the computer memory. The sorter module is also configured to store a file identifier corresponding to the loaded file in the first list of file identifiers, to store the first list on a non-volatile memory (e.g., hard-disk, flash memory, etc.), and to access the stored first list during a subsequent boot operation. In some embodiments, the system comprises an analyzer module, and the loader module is configured to store the files in a cache memory. The analyzer module is configured to access the files from the cache memory, and to analyze the accessed files.

In another aspect, various embodiments feature another system for enhancing performance of a software program. The system includes a sorter module to receive a first list of file identifies, each being associated with a respective file. For each file identifier in the first list, the sorter module: (a) compares a first attribute of the associated file with a predetermined threshold, and (b) based on the comparison, selectively adds that file identifier to a second list. Moreover, the sorter module sorts the second list based on a second attribute of the files associated with the file identifiers in the second list. The system includes a loader module for selecting, in sorted order, each file identifier in the sorted second list, and for loading the file associated with the selected file identifier.

Other aspects and advantages of the invention will become apparent from the following drawings, detailed description, and claims, all of which illustrate the principles of the invention, by way of example only.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, like reference characters generally refer to the same parts throughout the different views. Also, the drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention.

FIG. **1** schematically illustrates a conventional system for loading several files;

FIG. **2** schematically illustrates a system for efficiently loading several files according to one embodiment;

FIG. **3** illustrates a process for loading several files according to one embodiment;

FIG. **4** illustrates another process for loading several files according to another embodiment; and

FIG. **5** schematically depicts a system for efficiently loading files according to one embodiment.

DETAILED DESCRIPTION

A computer hard drive typically includes mechanical parts such as several rotating magnetic disks and one or more read/write heads that access the disks. Data representing the various files used by the computer are stored in cylindrical tracks on one of the magnetic disks. Before the file data can be accessed, i.e., read and/or written, the disk head is moved to a location over the track where that file (or portion of the file) is located. The disk-head movement takes some time, typically on the order of 3-12 ms on an average per file access, depending on the size and quality of the disk drive. In fact, the seek time, i.e., the time required to position the disk head at a required location, is often a significant bottleneck of accessing and loading files.

In general, there is no correlation between the physical position of a file on the hard disk and the position of its record (i.e., the entry of the file identifier) in the file system database. As a result, in a conventional system in which numerous files are accessed in the order of their record in the file-system database, the disk head typically moves back and forth in a far from optimal manner. For example, FIG. **1** depicts a list **102** of file identifiers associated with the files to be accessed. In order to access file **1**, the disk head **104** is moved forward from its current location on track **112** to track **114**. Then, to access file **2**, the disk head **104** is moved backward to track **116**. Finally, the disk head is moved to track **118**, to access file **3**. While accessing a large number of files, such back and forth movements can add a significant delay to the file loading process.

With reference to FIG. **2**, in an exemplary system **200** according to one embodiment, the file identifiers in the list **102** are sorted according to the physical positions of the associated files on the disk, resulting in a sorted list **206**. The information about the physical positions of the files is typically provided by the operating system from a file-system database. From the sorted list **206**, file **2** is accessed first, so that the disk head **104** moves from its current location on track **112** to track **116**. Subsequently, to access file **3**, the disk head **104** is moved to track **118**, and then to track **114**, to access file **1**. Thus, the disk head **104** is moved only in the forward direction. Moreover, during a series of consecutive file accesses, the total distance by which the disk head **104** is moved is minimized because the files are accessed in the order of their physical position. Therefore, the system **200** minimizes the total seek time, which can minimize the time required to load several files to be processed.

With reference to FIG. **3**, in step **302** the file-system database entries of one or more specified folders are browsed using "FindFirstFile"/"FindNextFile" functions commonly provided by the operating system. These functions enable iterating over the files located in permanent storage, by providing a list of file identifiers that are also stored in the file-system database. One file is associated with each file identifier, and as such, this first list includes the file identifiers associated with all of the files to be processed by the software.

For each file identifier in the list, in step **304** the size of the associated file is compared with a certain threshold (e.g., 1 Kbyte). A file smaller in size than the threshold may not be stored on the hard drive, and instead, may be stored in the directory record (e.g. a Master File Table (MFT) record) in the file-system database maintained by the operating system. Therefore, such a file is processed immediately in step **306**, because the time to seek that file is not related to disk-head movement. In other alternative implementations, the files that are below this size threshold may be retrieved subsequent to retrieving the larger files from the disk.

Any file that is larger than the threshold is stored somewhere on the hard drive. In step **308**, the file identifier associated such a file is stored in a second list. Various other file parameters, such as the volume handle, the unique file id, and the file start position (cluster) are also stored and associated with the file identifier in the second list. The steps **302**, **304**, and the step **306** or **308** are repeated until all of the file identifiers in the first list have been analyzed.

In step **310**, the second list of file identifiers is sorted based on the starting cluster of the associated files. The starting cluster represents the physical position of a file on the hard drive. In step **312**, a file identifier is selected from the sorted second list in order, i.e., in the order of the physical position of the associated file, and is loaded in computer memory using standard functions provided by the operating system. The full path of the file to determine its location may be obtained using information stored in the second list.

The loaded file is analyzed in step **314**. The specific analysis performed depends on the overall functionality of the software product. For example, a virus/malware scanner may scan the loaded file for virus, adware, malware, spyware etc. Similarly, a photo-viewer may display an image in the file in a photo album. A file transfer, backup, and/or multicopy program may copy the file to a new location on the disk drive or to another computer over a network. Compilers and data-mining software products may also access a large number of files. The steps **312**, **314** are repeated for all of the file identifiers in the sorted second list. In some embodiments, all or a subset of files are loaded in the memory and then the loaded files are analyzed. As described above with reference to FIG. **2**, because the files are loaded in the order of their physical position on the hard drive according to process **300**, unnecessary disk-head movements are avoided or mitigated, which can substantially decrease the time required to load several files to be processed by the software product.

In an exemplary process **400** described with reference to FIG. **4**, the files to be processed by the software are not specified in terms of one or more folders or a disk. As the software begins to execute, in step **402**, a check is performed to determine if a list of files required by the software exists, and if the list is up to date. If the list does not exist or is not up to date, each file loaded during the initialization and/or execution of the software is recorded in step **404**. The list is stored for subsequent use before the software application terminates.

During a subsequent execution of the software, the list of required files may be found in step **402**. In step **406**, that list is sorted in the order of the physical positions of the files. The information about the physical position of a file may be obtained from the operating system using a unique file identifier associated with the file. Then in step **408**, the files in the sorted list are loaded in order and may be stored in cache memory. The execution of the software (e.g., the boot component of the operating system) is suspended during the steps **406** and **408** while the required files are loaded. When execution of the software continues, the required files are accessed from the cache memory. Once again, the process **400** enhances software performance by decreasing or minimizing the total time required to load all of the files needed by the software, because the files are loaded in the order of their physical position on the hard drive, thereby avoiding unnecessary disk-head movements.

Referring to FIG. **5**, a hardware/software system **500** includes a computer **502** having a processor **504**, a hard drive **506**, main memory **508**, and cache memory **510**. The computer **502** also includes an operating system (OS) **512** that includes a file-system database **514** and an os-file-loader **516** to access files from the hard drive **506**. Moreover, the system **500** includes a software application **520** which includes a sorter module **522**, a loader module **524**, and a file analyzer **526**.

The sorter module **522** receives a list of file identifiers associated with the files to be processes by the application **520** from the file-system database **514**. Alternatively, the sorter module **522** can record the files processed by the software **520** and store a list of those files. Generally, the files are located on the hard drive **506**, but some small files may be located in a table maintained by the file-system database **514**.

The sorter module **522** optionally stores and sorts a list of file identifiers selected from the first list received or generated by the sorter module **522**. Then, using the os-file-loader **516** the loader module **524** loads the files in the sorted order, as described with reference to FIGS. **3** and **4**. These files are accessed from the hard drive **506** and may be stored in the main memory **508** or the cache memory **510**. The file analyzer module **526** processes the files in the cache and/or main memories using the processes or **504**.

Each functional component described above (e.g., the sorter module, the loader module, and the file-analyzer module) may be implemented as stand-alone software components or as a single functional module. In some embodiments the components may set aside portions of a computer's random access memory to provide control logic that affects the interception, scanning and presentation steps described above. In such an embodiment, the program or programs may be written in any one of a number of high-level languages, such as FORTRAN, PASCAL, C, C++, C#, Java, Tcl, PERL, or BASIC. Further, the program can be written in a script, macro, or functionality embedded in commercially available software, such as EXCEL or VISUAL BASIC.

Additionally, the software may be implemented in an assembly language directed to a microprocessor resident on a computer. For example, the software can be implemented in Intel 80×86 assembly language if it is configured to run on an IBM PC or PC clone. The software may be embedded on an article of manufacture including, but not limited to, computer-readable program means such as a floppy disk, a hard disk, an optical disk, a magnetic tape, a PROM, an EPROM, or CD-ROM.

The invention can be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The foregoing embodiments are therefore to be considered in all respects illustrative rather than limiting on the invention described herein.

What is claimed is:

1. A computer-implemented method of loading, in computer memory, files required by a boot program, the method comprising:

using at least one data processing device to:

record, during at least one execution of the boot program, each file loaded in the computer memory;

store, for each of the loaded files, a respective file identifier in a first list of file identifiers;

store the first list on a non-volatile memory; and

access the stored first list during subsequent execution of the boot program;

for each file identifier in the accessed first list, (i) comparing a first attribute of the file corresponding to that file identifier with a predetermined threshold to identify whether retrieval of that file requires movement of a disk-head or access to a directory structure, and (ii) when the first attribute of that file exceeds the predetermined threshold, selectively adding that file identifier to a second list designated for files that require movement of the disk-head to access;

sorting the second list based on a second attribute of the files corresponding to the file identifiers in the second list;

selecting, in sorted order, a file identifier in the sorted second list;

loading the file corresponding to the selected file identifier; and

repeating the selecting and loading steps until each file identifier in the sorted second list is selected.

2. The method of claim **1**, wherein the boot program comprises at least one of a virus scanner, a spyware scanner, an adware scanner, a malware scanner, a backup program, a multicopy program, a compiler, and a data-mining program.

3. The method of claim **1**, wherein each of the file identifiers comprises a file entry in a directory record.

4. The method of claim **1**, wherein the second attribute comprises file location.

5. The method of claim **4**, wherein the location comprises a cluster location.

6. The method of claim **1**, wherein the first attribute comprises file size and the threshold is one Kbyte.

7. The method of claim **1**, further comprising, after loading the file, analyzing the file.

8. The method of claim **7**, wherein analyzing comprises scanning the loaded file for at least one of viruses, spyware, adware, and malware.

9. The method of claim **1**, wherein loading comprises storing the file in a cache memory, the method further comprising:

accessing the file from the cache memory; and

analyzing the accessed file.

10. The method of claim **1**, further comprising, for each file identifier in the accessed first list, analyzing the file corresponding to that file identifier when the first attribute of that file does not exceed the predetermined threshold.

11. The method of claim **1**, further comprising, for each file identifier in the accessed first list, accessing the file corresponding to that file identifier from the directory structure without use of the disk-head and analyzing the accessed file, when the first attribute of that file is less than or equal to the predetermined threshold.

12. The method of claim **1**, wherein the directory structure is a Master File Table in a file system database maintained by an operating system.

13. A system for enhancing performance of a software program, the system comprising:

a processor;

a hard drive;

a memory; and

a boot program stored on the hard drive, the boot program comprising:

a sorter module configured to:

(i) use the processor to:

record, during at least one execution of the boot program, each file loaded in the memory;

store, for each of the loaded files, a respective file identifier in a first list of file identifiers;

store the first list on the hard drive; and

access the stored first list during subsequent execution of the boot program;

(ii) for each file identifier in the first list, (a) compare a first attribute of the file corresponding to that file identifier with a predetermined threshold to identify whether retrieval of that file requires movement of a disk-head or access to a directory structure, and (b) when the first attribute of that file exceeds the predetermined threshold, selectively add that file identifier to a second list designated for files that require movement of the disk-head to access; and

(iii) use the processor to sort the second list based on a second attribute of the files corresponding to the file identifiers in the second list; and

a loader module configured to use the processor to:

select, in sorted order, each file identifier in the sorted second list; and

load the files corresponding to the selected file identifiers into the memory.

14. The system of claim **13**, wherein the boot program comprises at least one of a virus scanner, a spyware scanner, an adware scanner, a malware scanner, a backup program, a multicopy program, a compiler, and a data-mining program.

15. The system of claim **13**, wherein each of the file identifiers comprises a file entry in a directory record.

16. The system of claim **13**, wherein the second attribute comprises file location on the hard drive.

17. The system of claim **16**, wherein the file location comprises a cluster location.

18. The system of claim **13**, wherein the first attribute comprises file size and the threshold is one Kbyte.

19. The system of claim **13**, wherein the boot program further comprises an analyzer module configured to analyze each of the loaded files using the processor.

20. The system of claim **19**, wherein the analyzer module is further configured to scan each of the loaded files for at least one of viruses, spyware, adware, and malware.

21. The system of claim **13**, wherein the boot program further comprises an analyzer module, and wherein:

the loader module is configured to store the files in a cache memory; and

the analyzer module is configured to access the files from the cache memory, and to analyze the accessed files.

22. The system of claim **13**, wherein the boot program further comprises an analyzer module configured to analyze, for each file identifier in the first list, the file corresponding to that file identifier when the first attribute of that file does not exceed the predetermined threshold.

23. The system of claim **13**, wherein the sorter module is configured to, for each file identifier in the accessed first list, access the file corresponding to that file identifier from the directory structure without use of the disk-head and cause the accessed file to be analyzed, when the first attribute of that file is less than or equal to the predetermined threshold.

24. The system of claim **13**, wherein the directory structure is a Master File Table in a file system database maintained by an operating system.

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